

Exercise	1	2	3	Total
100%	5	6	4	15
Points				

Name:

Extragalactic Astronomy and Cosmology

Homework 4 - Lecture 9 - Cosmic Dynamics

Due date: October 3rd

1 Cosmological constant

Suppose the energy density of the cosmological constant is equal to the present critical density $\epsilon_{\Lambda} = \epsilon_{c,0} = 5200 \text{ MeV m}^{-3}$. What is the total energy of the cosmological constant within a sphere 1 AU in radius? What is the rest energy of the Sun ? Comparing these two numbers, do you expect the cosmological constant to have a significant effect on the motion of planets within the solar system?

2 Einstein's static Universe

Consider Einstein's static Universe as described in Section 4.4 of Ryden. In this model, the attractive force of the matter density ρ is exactly balanced by the repulsive force of the cosmological constant, $\Lambda = 4\pi G\rho$. Suppose that some of the matter is converted into radiation (by stars, for instance). Will the Universe start to expand or contract? Explain your answer.

3 Density and curvature

If $\rho = 2.5 \times 10^{-27} \text{ kg m}^{-3}$, what is the radius of curvature R_0 of Einstein's static Universe? How long would it take a photon to circumnavigate such a Universe?